REMARKS

Claims 1-3, 5-8, 10, 11 and 13-19 are pending in the present Application. Claim 8 is canceled and new claim 20 is added with this Amendment.

Claim 1 has been amended to recite that the plating solution is suitable for filling vias in a substrate with copper. Claims 6 and 10 have been amended to recite a method for filling vias in a substrate with copper. These amendments are supported by the Specification at page 3, lines 24-29. Claims 7 and 11 have been amended only so that their preambles refer back to amended claims 6 and 10, respectively. Newly added claim 20 is supported by the Specification at page 18, line 31 to page 19, line 3. No new matter is added with this Amendment.

Claims 1-3, 5-8, 10-11, 13, 15, 16, 18 and 19 have been rejected under 35 USC § 103(a) as being unpatentable over Eckles (U.S. 4,384,930) in combination with Okinaka et al. (U.S. 4,469,564). Applicants respectfully traverse.

Applicants' invention is directed to a copper plating bath, and method using such bath, comprising copper, water, a water-soluble chlorine compound, a brightening agent compound represented by the formula –X-S-Y-, and a thiol-reactive compound chosen from certain compounds. Thus, Applicants' copper plating bath *requires* both a brightening agent compound and a thiol-reactive compound. Applicants' claimed copper plating solution is suitable for filling vias on a substrate with copper. Applicants' claimed method provides for the filling of vias with copper. Such plating solution is capable of filling vias *without voids*.

Eckles is directed to an electroplating bath containing at least one surfactant of a given formula, such surfactants providing bright and level metal deposits. Such electroplating bath may contain a brightening compound, and such brightening compounds are typically "carbonyl-containing compounds which may be either aromatic carbonyl-containing compounds or aliphatic carbonyl-containing compounds." Such carbonyl-containing compounds are "aldehydes, ketones and carboxylic acids". See column 5, lines 7-13. This patent does not disclose or suggest brightening agents of the formula –X-S-Y- as required by the present claims. Accordingly, the Eckles patent neither teaches nor suggests the *combination* of Applicants' brightening agent with a thiol-reactive compound. Since Eckles does not teach or suggest

Applicants' brightening compounds, neither does Eckles teach or suggest the problems with such brightening compounds that are solved by Applicants' invention. Further, Eckles neither teaches nor suggests the filling of vias in a substrate with copper. In fact, there is no mention of via-filling at all in Eckles. These is nothing in Eckles that teaches or suggests that Applicants' claimed plating solution would fill vias with copper without void formation.

The Okinaka et al. patent does not fill the deficiencies of Eckles. This patent discloses a copper electroplating bath containing certain polysulfide compounds. Such polysulfide compounds are disclosed to be ductility increasers. See column 4, lines 50-51 and column 6, lines 3-4. This patent neither teaches nor suggests the use of these polysulfide compounds as brightening agents. Further, this patent fails to recognize the problem of the formation of –X-S$^-$ compounds resulting from the use of these polysulfide compounds as brightening agents. Such –X-S$^-$ compounds lead to a deterioration in the via-filling property of the copper plating solution and in the appearance of the plated deposit. See the present Application generally starting at page 7 line 11 through page 9, line 14, and particularly at page 7, lines 11-16. Still further, the Okinaka patent neither discloses nor suggests the use of thiol-reactive compounds, such as aldehydes, in copper electroplating baths. Accordingly, this patent neither teaches nor suggests the use of thiol-reactive compounds with polysulfide compounds. Okinaka also fails to teach or suggest filling vias in a substrate with copper. In fact, via-filling is neither taught nor suggested in the Okinaka patent.

There is no motivation to combine these references. Void formation during via-filling is a problem when conventional copper plating solutions are used. Applicants have surprisingly found that their claimed plating solution provides copper-filled vias without voids. There is nothing in Eckles or Okinaka, either alone or in combination, that teaches or suggests that Applicants' claimed copper plating solutions and methods would provide for the filling of vias with copper without voids. In fact, there is nothing in either of these references that suggests filling vias at all or recognizes the problems of conventional copper plating solutions in filling vias. If, for the sake of argument, one were to combine Eckles and Okinaka, one would not be lead to use any composition for the filling of vias or that such vias could be filled without void formation. Neither reference alone or in combination teaches or suggests a plating solution containing a combination of a polysulfide compound and a thiol-reactive compound, such as an

aldehyde, for filling vias without voids. Further, nothing in either of these references recognizes that control of certain brightening agent cleavage products allows for the copper filling of vias without void formation. Nothing in either of these patents alone, or in combination, teaches or suggests that brightening agent cleavage products cause void formation during the filling of vias with copper. Thus, nothing in these patents teaches or suggests Applicant's method of filling vias comprising the step of controlling such cleavage products.

Applicants submit that the Examiner has not made out a prima facie case of obviousness and respectfully request that this rejection be withdrawn.

Claims 14 and 17 have been rejected under 35 USC §103(a) as being unpatentable over Eckles (US 4,384,930) in combination with Okinaka et al. (US 4,469,564) and further in view of Uzoh et al. (US 6,355,153). Applicants respectfully traverse.

Ecklea and Okinaka et al. are discussed above, both individually and in combination.

Uzoh et al. is directed to chip interconnect and packaging methods in which portions of a seed layer are selectively removed from the top surface of a substrate and a conductive material is deposited in the cavities of the substrate. The conductive material is deposited from a plating bath which may contain a metal oxidizing agent. This patent does not fill the deficiencies of Eckles, Okinaka or a combination of these two. Nothing in Uzoh et al. teaches or suggests the use of thiol-reactive compound in the plating bath. Further, nothing in this patent teaches or suggests the combination of a thiol-reactive compound with a compound of the formula –X-S-Y-. Still further, Uzoh et al. neither teach nor suggest the reduction of problems in via-filling using a copper plating bath containing a brightening agent of the formula –X-S-Y- by the addition of a thiol-reactive compound to the copper plating bath to control brightening agent cleavage products. If, for the sake of argument, one were to combine Uzoh et al. with a combination of Okinaka and Eckles, one would at best have a plating bath containing the surfactant of Eckles and the polysulfide compound of Okinaka et al. and the metal oxidizing agent of Uzoh et al. Nothing in any of these references alone or in any combination teaches or suggests filling vias in a substrate with copper using Applicant's claimed plating solution, and in particular that such

vias can be filled without voids. Applicants submit that the Examiner has not made out a prima facie case of obviousness and respectfully request that this rejection be withdrawn.

Even though Applicants do not believe that that Examiner has made out any prima facie case of obviousness, Applicants wish to point to Examples 2 and 3 of the Specification. These examples show that MPS, a brightening agent cleavage product, when present in certain amounts, adversely affects the via-filling performance of a copper plating bath, whereas the present plating baths containing a thiol-reactive compound provide substantially perfect via filling even when MPS is present. Such a result could not be predicted from the cited references.

Applicants respectfully request favorable reconsideration in the form of a notice of allowance.

Respectfully submitted,

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